Effectiveness of essential oils of *Eucalyptus camaldulensis* and *Cymbopogon citratus* in protecting stored rice against *Sitophilus oryzae* and *Sitotroga cerealella*

CHEMICAL control methods are widely used on-farm for storage issue, but because of the effects of pesticides on human health and on environment, it is necessary to explore new measures to limit these risks.

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Objectives

The objective of this study is to develop alternative technologies based on the treatment of storage bags with the essential oils of *Eucalyptus camaldulensis* and *Cymbopogon citratus* to protect stored rice paddy against insects pests.

Material et methods

Two methods were used: impregnation of gunny bags and treatment of cotton bags (20 cm x 25 cm). In the first case, gunny bags were soaked in oils diluted in alcohol at various concentrations (3%, 4% and 5%). In the second case, cotton bag was treated either with a single oil (dose: 0.25 ml/bag), or with the two oils (dose: 0.125 ml/oil/bag). Twenty-four hours after application of the oils, 100 g of rice paddy were placed in each bag, and then each was artificially infested with 10 pairs of adults of *Sitophilus oryzae* and *Sitotroga cerealella* (Figure 1). After 90 days of storage, we assessed the populations of the two pest species and the damage inflicted on the stored rice.

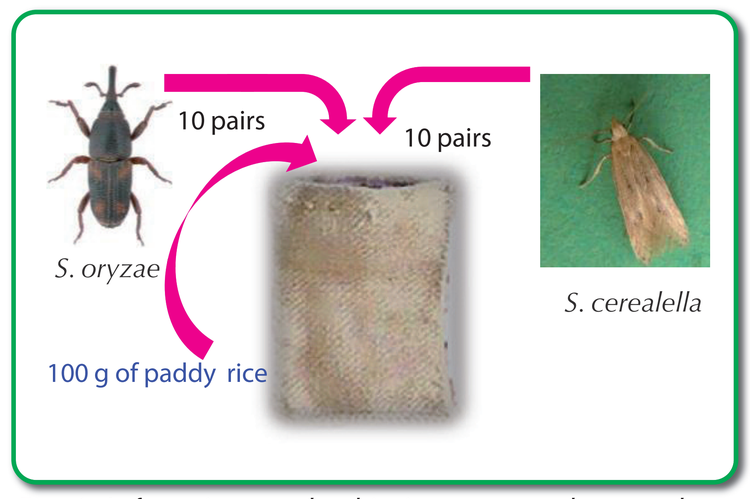

Fig. 1. Infestation method in impregnated gunny bag.

Results

Under gunny bags impregnation conditions, the essential oil of *C. citratus* was effective enough against *S. cerealella* even at low doses but *E. camaldulensis* appeared to be the most effective on *S. oryzae* (Table I). The weight losses of rice paddy were more limited when treated with *C. citratus* than in the checks (Figure 2). Under cotton bags treatment, the study showed clearly that the mixture of the two products provided the best protection of rice paddy against the two targeted pests. The weight loss scored only 1.8% after three months of storage compared to 8.7% recorded on the untreated bags (Table II).

Table I. Effect of essential oils on *Sitophilus oryzae* and *Sitotroga cerealella* emerged adults in stored paddy rice inside gunny bags.

Treatments	Emerged adults of *S. oryzae*	Emerged adults of *S. cerealella*
Untreated check	51.0 ± 6.2a	345.7 ± 24.9a
Cymbopogon citratus 3%	51.5 ± 8.4a	113.2 ± 9.6b
Cymbopogon citratus 4%	37.2 ± 3.5a	98.5 ± 8.9b
Cymbopogon citratus 5%	21.2 ± 2.7b	88.7 ± 4.0b
Eucalyptus camaldulensis 3%	20.2 ± 2.0b	263.7 ± 20.4a
Eucalyptus camaldulensis 4%	15.2 ± 2.6b	280.0 ± 19.4a
Eucalyptus camaldulensis 5%	9.5 ±3.1b	266.2 ± 32.4a

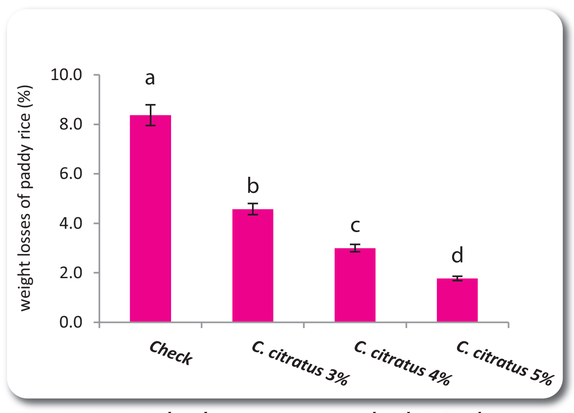

Fig. 2. Weight losses recorded 90 days after storage in impregnated gunny bags.

Table II. Impact of cotton bags treatment on paddy rice weight losses.

Treatments	Rice paddy weight loss (%)
Cotton bag (Check 1)	8.7b
Cotton bag + plastic film (Check 2)	4.8ab
Cymbopogon + cotton bag	3.5ab
Eucalyptus + cotton bag	3.9ab
Eucalyptus + *Cymbopogon* + cotton bag	4.8ab
Cymbopogon + cotton bag + plastic film	3.1ab
Eucalyptus + cotton bag + plastic film	3.8ab
Eucalyptus + *Cymbopogon* + cotton bags + plastic film	1.8a

Conclusion and suggestion for future way

The use of the essential oils of *C. citratus* and *E. camalsulensis* appeared to be a promising method for protecting stored rice against *S. cerealella* and *S. oryzae*. However, the method needs some improvement in order to make the technology cheaper for a large access by end users.

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